

## Neutron Powder Diffractometer (NPD)

The Neutron Powder Diffractometer (NPD) design allows for studies of complex structures, internal strain measurements, and phase transformations. Examples of experiments include studies of internal stresses and phase transformations in shape memory and superelastic NiTi; phases of Pu alloys; strains in nanocomposites; residual strains in intermetallic composites, NiAl; strain measurements in tempered ceramics; and elastic and plastic anisotropic effects in fcc polycrystals. The standard collimation produces a 5 x 10-mm beam at the sample position. Four detector banks (each 31  $^3\text{He}$  30-cm tubes) sit symmetrically about the sample position at  $\pm 90^\circ$  and  $\pm 148^\circ$ , covering a d-spacing range of 0.25 to 4 Å. The resolution in the backscattering detectors is  $\Delta d/d = 0.15\%$  and at  $90^\circ$  it is 0.25%. For strain measurements, a set of radial collimators defines the diffracted beam volume, and a focusing optic is available to increase the beam intensity when sampling small volumes. Ancillary equipment available includes a closed-cycle refrigerator, an orange cryostat, a high-temperature furnace with atmosphere control, a compact stress rig, and a beam collimation system for strain measurements.

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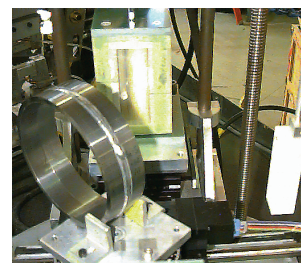
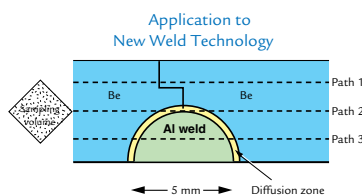


◀ Don Brown and Mark Bourke examine the sample rig.

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### Strain Field Measurements in Bulk Samples Provide Valuable Information for Remanufacturing Process Design

- Neutron diffraction measurements of residual strain in bulk materials are provided by neutron diffraction experiments
- Strain characterization in beryllium welds has application to remanufacturing process development



Sample Beryllium Weld for Neutron Strain Measurement

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### NPD Specifications

detector banks, d-spacing range (approximate), and resolution	+/- 20°(future) +/- 45°(future) +/- 90° +/-148°	1.2-15.8 Å 0.65-7.6 Å 0.35-4.2 Å 0.25-3.1 Å	0.91-1.5% 0.37-0.62% 0.25% 0.15%
Moderator	Chilled water at 283 K		
Sample environment	10-300 K; closed-cycle refrigerator; room-temperature-access liquid-He dewar, 1.2-300 K; stress rig; uniaxial tension on compressor (+/- 50 kN, RT > 300°C); controlled atmosphere furnace (RT > 1400°C); vacuum furnace (RT > 700°C); manipulation and radial collimation system > 1 > 64 mm <sup>3</sup> (sampling volume)		
Maximum beam size at sample	5.0 cm in height x 1 cm in diameter		
Experiment duration	4 to 48 hours		